DRAFT

PROCESS AREAS RADIOLOGICAL MATERIALS REMOVAL ACTION PLAN

YERINGTON MINE SITE

July 6, 2010

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LIST OF ACRONYMS AND ABREVIATIONS

Anaconda	Anaconda Company
ABP	Acid-Base Potential
AOC	Administrative Order on Consent
ARC	Atlantic Richfield Company
ASTM	American Society of Testing and Materials
BLM	Bureau of Land Management
CERCLA	Comprehensive Environmental, Response, Compensation, and Liability Act
CFR	Code of Federal Regulations
DAC	Derived Air Concentrations
DSR	Data Summary Report
DOI	Department of the Interior
EPA	Environmental Protection Agency
ERGS	Environmental Radiation Ground Scanner
FRM	Federal Response Method
HASP	Health and Safety Plan
HSSE	Health Security, Safety and Environmental
JSA	Job Safety Analyses
NDEP	Nevada Division of Environmental Protection
Order	Administrative Order
OSHA	Occupational Safety and Health Administration
OSLD	Optically Stimulated Luminescent Dosimeters
OU	Operable Unit
PCB	Polychlorinated Biphenyl
PEL	Permissible Exposure Levels
PPE	Personal Protective Equipment
PRG	Preliminary Remediation Goal
QAPP	Quality Assurance Project Plan
RCA	Radiological Control Area
RCRA	Resource Conservation and Recovery Act
RAP	Removal Action Plan
RI/FS	Remedial Investigation and Feasibility Study
RPM	Remedial Project Manager
Site	Yerington Mine Site
SIMOPS	Simultaneous operations
SOW	Scope of Work
START	Superfund Technical Assessment and Response Team
SVOC	Semi-Volatile Organic Compound
TENORM	Technologically Enhanced Naturally-Occurring Radioactive Materials
TLD	Thermoluminescent Dosimeters
TPH	Total Petroleum Hydrocarbons
TSEA	Task Safety and Environmental Assessment
USAEC	U.S. Atomic Energy Commission
UTM	Universal Transverse Mercator
VLT	Vat Leach Tailings
VOC	Volatile Organic Compound
WRA	Work Risk Assessment
WRCC	Western Regional Climate Center

°F	degrees Fahrenheit
bgs	below ground surface
cm^2	square centimeters
cpm	counts per minute
dpm	disintegrations per minute
g/l	grams per liter
gpm	gallons per minute
lpm	liters per minute
mg/m	milligrams per meter
mm	millimeters
mph	miles per hour
mrem	millirem
pCi/g	picoCuries per gram
pCi/l	picoCuries per liter
rem	roentgen equivalent man

SECTION 1.0
INTRODUCTION

This Draft Process Areas Radiological Materials Removal Action Plan (draft RAP) dated July 2, 2010 has been prepared by Atlantic Richfield Company (ARC) pursuant to the Administrative Order on Consent and attached Scope of Work[1] (AOC/SOW; Docket No. 9-2009-0010) dated April 21, 2009, issued to ARC by the U.S. Environmental Protection Agency (EPA). This draft RAP is also based on subsequent correspondence and meetings, culminating in a meeting held on June 16, 2010 at EPA's office in San Francisco, California where ARC and EPA agreed on the approach for the removal of soils impacted by ore beneficiation solutions within the Process Areas of the Yerington Mine Site (Site), as presented in this draft RAP. The Site is shown on Figure 1-1 and the operable units OUs) at the Site, including the Process Areas Operable Unit (OU-3), are shown on Figure 1-2. The Process Areas, approximately 5,000 feet long and 2,000 feet wide (about 230 acres), includes ore beneficiation and ancillary support facilities located in the central portion of the Site.

As specifically agreed upon in the June 16th meeting, this draft RAP addresses: 1) discrete areas of impacted soils around the leach vats, solution tanks and precipitation plant; and 2) the soils within the perimeter of the W-3 dump leach surge pond located northeast of the precipitation plant. These areas are outlined on Figure 1-3, which also depicts the sub-areas defined by Brown and Caldwell (2005) during initial soils characterization activities. Soils in these areas have been impacted by ore beneficiation solutions that contained technologically enhanced naturally occurring radioactive materials (TENORM). Impacted soils, herein referred to as 'TENORM waste', were defined by sampling and analyses and radiometric surveys in the *Anaconda Mine Radiation Assessment Letter Report* prepared by the Superfund Technical Assessment and Response Team (START, 2008), referred to as the 'START Report' in this draft RAP.

[1] Administrative Order on Consent and Settlement Agreement for Past Response Costs Anaconda Copper Mine, Yerington Nevada; U.S. EPA Region IX; Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Docket No. 09-2009-0010.

1.1 Removal Action Plan Objective

As stated in the AOC/SOW, the objective of the Process Areas radiological materials removal action is to reduce potential risks to on-Site workers. This objective will be accomplished by excavating the TENORM waste (soils only, no other radiological wastes will be removed as part of this removal action), and then conveying the excavated materials to an appropriate off-Site repository under applicable state and federal regulations. The action level of 3.79 picoCuries per gram (pCi/g) of Ra-226 in Process Areas soils, as described in the START Report, was selected by EPA as the basis of the removal action. Soils with elevated radiometric readings, identified in the START Report as discrete areas around the leach vats, solution tanks and precipitation plant, and within the perimeter of the W-3 dump leach surge pond, have also been agreed upon by EPA and ARC as TENORM waste subject to the removal action.

1.2 Site Location and Description

The Site encompasses approximately 3,600 acres of land located about one-half mile west and northwest of the City of Yerington in Lyon County, Nevada (Figure 1-1). The Site is located in Mason Valley within the Walker River watershed. Agriculture is the principal economic activity in Mason Valley, typically hay and grain farming, onion production and some beef and dairy cattle ranches. The Walker River flows northerly and northeasterly between the Site and the City of Yerington (the river is within a quarter-mile of the southern portion of the site). The Paiute Tribe Indian Reservation is located approximately 2.5 miles north of the Site (Figure 1-1).

The physical setting of the Site is within the Basin-and-Range physiographic province, which is part of the Great Basin sagebrush-steppe ecosystem. Mason Valley occupies a structural graben (i.e., down-dropped faulted basin) typical of basin-and-range topography. The Singatse Range, located immediately south and west of the Site, is an uplifted mountain block that has been subjected to extensive hydrothermal alteration and metals mineralization in the geologic past. Mining and ore processing activities at the Site have resulted in modifications to the natural, pre-mining topography including a large open pit (occupied by a pit lake), waste rock and leached ore piles, and evaporation and tailings ponds.

The Site is located in a high desert environment characterized by an arid climate. Monthly average temperatures range from 33.3° F in December to 73.7° F in July. Annual average rainfall for the town of Yerington is only 5.3 inches per year, with lowest rainfall occurring between July and September Western Regional Climate Center (WRCC, 2007). Wind speed and direction at the Site are variable as a result of natural conditions and variable topographic features created by surface mining operations. Air quality and meteorological data collected since 2002 indicate that the dominant wind directions are to the north and the northeast (Brown and Caldwell, 2009a).

1.3 Phased RI Process

This draft RAP presents a removal action for TENORM waste in select portions of the Process Areas based on the assessment results summarized in the START Report, and as defined in discussions with EPA at the above-referenced June 16th meeting. The Process Areas will be subject to future remedial investigations and feasibility study (RI/FS) to support a final remedy pursuant to the Administrative Order for Remedial Investigation and Feasibility Study (RI/FS; EPA Docket No. 9-2007-0005), issued to ARC by EPA in 2007. Removal of the TENORM waste from the Process Areas, as described in this draft RAP, will be recognized in the preparation of a future revision of the RI Work Plan for the Process Areas.

1.4 Project Management Team

The project management team consists of EPA's Remedial Project Manager (RPM) and advising technical staff and ARC's Project Manager and technical staff. The Yerington Technical Work Group (representatives of the U.S. Bureau of Land Management [BLM], Nevada Division of Environmental Protection [NDEP] and others) support the project management team by reviewing work plans and related documents. Key project personnel for this Work Plan are listed in Table 1-1. EPA's RPM for this removal action is Ms. Nadia Hollan, who is assisted by Mr. Tom Dunkelman, EPA's On-Scene Coordinator. Technical support to the EPA is provided by EPA's subcontractors, CH2M Hill and Tetra Tech, Inc.

ARC's Project Manager is Mr. Jack Oman, who is assisted by Mr. John Batchelder and Mr. Shannon Dunlap. Brown and Caldwell is ARC's prime contractor. Chuck Zimmerman is Brown and Caldwell's project manager, with technical support provided by Guy Graening and Rich Mattucci, PE. Matthew Arno (Foxfire Scientific, Inc) provides technical support for radiological issues. Penny Bassett of Brown and Caldwell is the Site health and safety officer.

Table 1-1. Key Project Personnel

Personnel	**Project Role**	**Company**
EPA & Sub-Consultants		
Nadia Hollan	RPM	EPA Region 9
Tom Dunkelman	On-Scene Coordinator	EPA Region 9
	Technical Support	TetraTech
	Technical Support	CH2M Hill
Atlantic Richfield and Sub-Consultants		
Jack Oman	Project Manager	ARC
John Batchelder	Geology, Health and Safety	EnviroSolve
Shannon Dunlap	Construction Management	ARC
Chuck Zimmerman	BC Project Manager	Brown and Caldwell
Guy Graening	Environmental Engineer	Brown and Caldwell
Matt Arno	Radiological Issues	Foxfire Scientific
Penny Bassett	Site Health and Safety Officer	Brown and Caldwell

1.5 Project Schedule

ARC anticipates that the scope of activities described in this draft RAP will occur during the late third quarter (August-September) of 2010. Upon EPA approval of this draft (or revised) RAP and the completion of ARC's contractor procurement process, ARC will provide EPA with a more detailed schedule including any modifications to the dust control and air monitoring programs described below. ARC also anticipates that the duration of this removal action (i.e., excavation and conveyance to an off-Site repository) will be approximately 30 days.

1.6 Document Organization

Section 2.0 provides: 1) background information on the Process Areas including operational history, identification and description of ore beneficiation and ancillary support facilities, and a description of wastes derived from the beneficiation of the copper ore; and 2) relevant soil analytical results from the remedial investigations performed by ARC in 2004 (Brown and Caldwell, 2005) and from the START Report. Section 3.0 describes the areas subject to the removal action and the survey of the TENORM waste areas associated with the leach vats, solution tanks and precipitation plant. Section 4.0 presents the implementation plan including material quantities to be removed, project execution aspects of the removal action, excavation-related air monitoring, and information on the off-Site repository and the transportation of the excavated TENORM waste to this facility. Section 5.0 describes health and safety requirements for this removal action, and Section 6.0 lists the references cited in this draft RAP.

SECTION 2.0
BACKGROUND INFORMATION

This section provides background information for the Process Areas, and presents pertinent data from previous Site investigations performed in the Process Areas. These investigations have been used to: 1) define the areas to be excavated pursuant to this draft RAP (Figure 1-3); and 2) document the chemical character of the TENORM waste to be placed within an off-Site repository. Appendices A and B include these radiometric and chemical data.

2.1 Operational History

The following descriptions, similar to those presented in the Process Areas RI Work Plan (Brown and Caldwell, 2007), are based on research conducted by ARC at the Anaconda Mine archives located in Laramie, Wyoming (managed by the University of Wyoming) and the Site archives located near Yerington, Nevada (managed by the EPA).

2.1.1 Ore Beneficiation Operations

Copper in the Yerington District was initially discovered in the 1860s, with large-scale exploration of the porphyry copper system occurring in the early 1900s when the area was organized into a mining district by Empire-Nevada Copper Mining and Smelting Co. The Anaconda Company (Anaconda) became involved in the Site when it entered into a lease agreement and acquired the mining claims in 1941. The mine produced about 1.7 billion pounds of copper during its operating period (1953 to 1978).

Subsequent operators (e.g., CopperTek and Arimetco) used some of the buildings within the Process Areas for operational support, although the original ore beneficiation components remained largely inactive during this period. Ore beneficiation operations, including volumes and concentrations of materials, changed over time throughout the mine life. Descriptions of Anaconda's mining and ore beneficiation activities are provided below. Figure 1-3 shows the general locations of the features discussed in the following sections.

Mining

Anaconda mined the open pit from 1953 through 1978. Materials removed from the pit included: 1) oxide ore; 2) sulfide ore; 3) low-grade dump leach oxide ore; 4) low-grade sulfide ore; and 5) waste rock/overburden. Mining was conducted using electric- and diesel-powered shovels, bulldozers, scrapers, and 25-ton haul trucks (U.S. Bureau of Mines, 1958). As indicated above, the mineralogical character of the copper ore mined and beneficiated by Anaconda resulted in the presence of TENORM at the Site. The open pit was mined in 25-foot benches with an approximate 45 degree pit wall slope. Final dimensions of the mined pit were approximately 6,200 feet long, 2,500 feet wide and 800 feet deep. Groundwater was encountered at approximately 100 to 125 feet below ground surface (bgs), and wells were installed along the perimeter of the pit to de-water the fractured bedrock as mining progressed. Water was pumped from each of these wells at rates up to 900 gallons per minute (gpm), and a total of up to 2,800 gpm was primarily used for mining and ore beneficiation operations and water for the Weed Heights housing community (U.S. Bureau of Mines, 1958; Skillings Mining Review, 1972).

Crushing and Grinding

Oxide and sulfide ores were crushed prior to leaching or milling. Crushing was performed in two steps for oxide ore and three steps for sulfide ore. All ores underwent coarse crushing in the Primary Crusher, a 54-inch gyratory crusher that produced a 5-inch minus material. This product exited the crusher by conveyor at a rate of approximately 1,400 tons per hour and was stored in oxide or sulfide Coarse Ore Storage piles prior to being conveyed to the Secondary Crusher. These ores were further reduced to 7/16-inch minus using standard and short-head cone crushers.

Oxide ores exited the Secondary Crusher through an underground conveyor to the Sample Tower where a sample was collected for assay and water was sprayed onto the crushed ore to agglomerate fine material as well as control dust (U.S. Bureau of Mines, 1958; Anaconda, 1954). Sulfide ores underwent additional crushing at the Sulfide Ore Crushing and Stockpile area located at the northwest end of the Leach Vats. Fine grinding of the sulfide ore to a grain size between 20- and 200-mesh particle size was necessary for flotation of the ore, and was accomplished using several rod and ball mills in sequence (Skillings Mining Review, 1972).

Oxide Ore Leaching

Oxide ores were loaded into the Leach Vats by conveyor and overhead loading bridge with the agglomerated ore from the Secondary Crusher, and bedded into a tank in a manner to prevent segregation and allow uninhibited circulation of leach solutions within the tank. Each tank had a capacity to hold approximately 12,000 dry tons of ore and 800,000 gallons of solution when filled to within 6 inches from the top. The vats typically operated on a 96-hour (4-day) or 120 hour (5-day) leaching cycle, with an additional 32- to 40-hour wash period, and 24 hours required to excavate and refill. The entire cycle required approximately 8 days, therefore eight leach vats were installed and used to maximize efficiency (U.S. Bureau of Mines, 1958).

A sulfuric acid leach solution was added to the oxide ores in the tanks at an initial concentration of 20 to 30 grams per liter (g/l) and circulated through the tanks for at least three hours until the acid content dropped to less than 2 g/l. The reinforced-concrete bottoms of the tanks were covered with timbers and cocoa matting as a filter to allow bottom drainage of solutions. Solutions were re-circulated and pumped at a rate of 2,000 gpm. Pregnant solutions were pumped to one of the two 286,000-gallon Solution Storage Tanks, and new solutions were transferred from the previous vat while acid was added to achieve the desired leaching strength of 40 to 60 g/l. This solution was re-circulated and then transferred to the next vat. This cycle continued for four or five leaching periods.

After leaching, the ore underwent three wash cycles which primarily used discharge water from the Peabody scrubber in the Acid Plant as well as fresh water from the supply well and leach final drain water (Anaconda, 1954). Approximately 1.4 million gallons of water were used per day for leach wash water. Spent ore, known as oxide tailings or vat leach tailings (VLT), was excavated from the Leach Vats by a clamshell digger mounted on a rolling overhead gantry crane which could position over any of the eight tanks. The digger would drop the leached ore into a hopper under which 25-ton end-dump trucks would drive, receive a load, and then haul the waste material to the VLT pile (i.e., Oxide Tailings Area or OU-6). The average time to excavate one tank was 16 hours at a rate of 40 truckloads per hour.

Cementation/Precipitation (Oxide Ore)

Copper was recovered from the leach solution by precipitating (i.e., "cementing") the copper using scrap iron by means of the following chemical conversion:

$$CuSO_4 + Fe \rightarrow FeSO_4 + Cu$$

The Precipitation Plant was divided into five separate banks or individual cells: 1) Primary, 2) Secondary, 3) Stripping/Settling, 4) Scavenger, and 5) Dump Leach. These banks of cells were operated in the following ways (Anaconda, 1954):

1. Primary Bank. 90,000 pounds of new scrap iron were loaded into each cell. Pregnant solution, with a concentration of approximately 15 to 25 g/l copper and 4-5 g/l sulfuric acid, was pumped through 4" lead pipes sunk into the concrete bottoms of the launder tanks and percolated upwards through the iron, overflowing to a weir box on the north east side at a rate of 700 to 900 gpm. The overflow solution discharged to the recirculation sump at the northwest end of the precipitation tanks where it was re-circulated back to the secondary bank. Re-circulation continued for four days, followed by the washing, removal and drying of the copper cement.
2. Secondary Bank. 90,000 pounds of new scrap iron was added to each cell. Solution discharged from the primary bank was re-circulated through the iron in the same manner as the primary bank. Solutions were re-circulated for five days at a pumping rate of 900 to 1,000 gpm, and then washed and excavated. Discharge solutions from the secondary bank were sent to the stripping/settling bank.
3. Stripping/Settling. This section was operated as pairs of tanks where the stripping tank contained iron and the settling tank did not. Solutions entering the stripping tank came solely from the secondary bank where additional copper was removed from the solutions prior to disposal. Solutions were re-circulated through these tanks for approximately 15 days. Final solutions from this area were sent to the Spent Solution Sump, and then ultimately returned to the Acid Plant for use as a slurry agent to wash the calcines from the acid plant to the evaporation ponds (Anaconda, 1954).

4. Scavenger. The purpose of the scavenger was to consume unused iron that was removed from the other precipitation banks after washing and separation in a trommel. Typically the residual iron was much finer and the precipitates form a dense mass. At some point, non-digestible residual material was removed from the system and discarded.
5. Dump Leach Primary and Secondary. Leach solution from the low-grade W-3 dump leach was kept entirely separate from the tank leach solutions so that the waste water could be reused. Dump leach precipitation operated similarly to the vat leach operation, and was initiated in 1965 (Mining Engineering, 1967). These solutions were re-circulated from the dump leach primary to the dump leach secondary through a separate dump leach recirculation sump.

Following cementation, the ore was washed in place and conveyed to the trommel hopper located at the southeast end of the precipitation tanks where it was further washed and the unused scrap iron separated from the copper cement. The copper cement was loaded onto hotplates (large flat drying surfaces that were heated underneath by propane gas to dry the material to approximately 12 percent moisture; Skillings Mining Review, 1972) prior to shipment. Copper cement product averaged 83 percent copper, which was hauled by trucks to the Wabuska rail spur and, eventually, to the Washoe Smelter in Anaconda, Montana for final smelting.

Concentrator (Sulfide Ore)

A froth flotation system was constructed in 1961 to beneficiate sulfide ores. Flotation and separation of sulfide ores was accomplished by: 1) mixing very finely ground ore (pulp) with water and a chemical (typically xanthate) to make the sulfide mineral hydrophobic; 2) sparging air and a surfactant chemical (typically pine oil) through the mixture to create a froth mixture; 3) allowing sulfide minerals in the pulp to float to the surface on air bubbles (froth mixture) in the aeration tank in the flotation circuit; and 4) skimming off the sulfide ores as a concentrate.

The Yerington concentrator was designed to separate solids in a 75-foot diameter thickener and re-grind the thickened solids to an even finer pulp size of minus 325 mesh (<44 microns). This re-ground material was sent through a scavenger floatation circuit, a cleaner circuit and a re-cleaner circuit. The final concentrate was thickened in a 50-foot diameter thickener, dewatered using a vacuum filter, and dried in a 24-foot rotary dryer.

The finished concentrate (average 28 percent copper) was hauled by trucks to the Wabuska rail spur and shipped to Anaconda, Montana for final smelting to a pure copper product. Operation of the concentrator required approximately 3,000 gpm of water, which was obtained from groundwater production wells and recycled water from decanting the sulfide tailings and other plant operations. Sulfide tailings were deposited as a slurry mixture of solids and water (Skillings Mining Review, 1972).

Sulfuric Acid Production

Sulfuric acid was produced at Yerington in the Fluosolids and Acid Plant from raw sulfur ore shipped to the Site from the Leviathan Mine. With the depletion of Leviathan ore in 1971, sulfur ore was purchased from various other sources. The production of sulfuric acid from sulfur ore can be broken down into 5 steps: (1) crushing, (2) grinding, (3) roasting, (4) dust precipitation, and (5) contact acid plant. The final product was 93 percent sulfuric acid that was used in the tank leach and the dump leach of the oxide ore. A summary of acid production steps are provided below (Anaconda, 1954 and U.S. Bureau of Mines, 1958):

1. Crushing. Two stage crushing was completed using a jaw crusher and short-head crusher to reduce the sulfur ore to minus one inch.
2. Grinding. Rod mills were used to further reduce the ore to minus 10 mesh (<2 mm) for feed to the flousolids roaster.
3. Roasting. Fluosolid roasters were used to roast the sulfur ore, and drive SO2 gas from the ore, which would then be converted to sulfuric acid in the subsequent steps. The ore was bedded into an 18-foot wide by 25-foot high reactor lined with insulating and fire brick. The bed of material was maintained at five feet and fluidizing air heated by propane was circulated to heat the ore to a temperature of 1,100^{o}F to oxidize the sulfur. The burned ore or "calcines" were removed from the bottom of the reactor and disposed of in the evaporation ponds via the Calcine Ditch using spent solution pumped from cementation.
4. Dust Precipitation. Gases leaving the reactor contained 10 to 12 percent SO_2 which were cooled, and sent through the Peabody scrubber and Cottrell electrostatic precipitator to remove dust. Precipitates were collected at a rate of about 800 pounds per day and contained 30 to 40% selenium with silica. Water from the scrubber was recycled and used as wash water in the leaching vats (U.S. Bureau of Mines, 1958). Selenium precipitates were sold and shipped off-site several times per year.

5. Contact Acid Plant. The SO_2 gas entered the contact acid plant by going through a primary and secondary converter where the SO_2 was converted to SO_3. The SO_3 gas then went through a heat exchanger and the adsorption tower where it was contacted with 98 percent sulfuric acid resulting in a diluted 93 percent sulfuric acid product for use in the plant. Approximately 450 tons of 93 percent sulfuric acid was produced per day from 600 tons per day of raw sulfur ore.

2.1.2 Ancillary Support Facilities

Truck Maintenance

Vehicles and equipment were serviced on-site in the Truck Shop and other support buildings such as the Wash Rack, Grease Shops, Tire Shop, and Equipment Garage. Descriptions of vehicle maintenance activities have not been found in historical mine records so the following descriptions are based on visual observations at the Site and standard mine practices. Anaconda maintained a fleet of 30 or more 25-ton haul trucks which were used for hauling ore form the pit to the primary crusher, hauling spent ore from the leach tanks to the VLT pile, and hauling sulfur ore to the acid plant crusher. Additional road trucks were used for hauling copper cement and concentrate to the Wabuska rail spur and hauling scrap iron back from Wabuska to the plant.

Based on historical photos, it appears that the fleet was likely parked in the current location of the Equipment Garage where daily vehicle fueling and greasing would have been conducted by a mobile ‘grease truck’. Historical photos also indicate that the area south of Burch Road opposite the Administration Building was used periodically for vehicle parking and equipment storage. More extensive maintenance activities such as motor repair and oil changes would have been conducted inside the Truck Shop. Tanks located inside the north end of the Truck Shop likely contained fresh motor oil and other vehicle fluids, and used motor oil was collected and stored in the Used Oil Tank.

The Wash Rack is an open concrete area with a sloping floor that collects in a drain sump on the north side and appears to drain to the Upper Truck Sludge Pond. The Wash Rack was used to hose off and steam clean a variety of vehicles and equipment, and may have included the use of degreaser soaps or solvents. Drainage from the Wash Rack was a likely source of hydrocarbons found in the Upper Truck Sludge Pond. Mine excavators, including the digging shovels, dozers, and scrapers, would likely have remained in the pit at all times and would have been serviced by the mobile grease truck in the pit, rather than traveling back to the Process Areas.

Laboratory Services

One primary, and a possible secondary, location in the Process Areas was established for laboratory analysis of mined materials for grade control and waste rock management. The south end of the Warehouse and Assay Laboratory Building was used as an assay laboratory, presumably for analysis of rock samples from the mine. Control samples such as leach solutions, precipitation solutions, and copper cement and concentrates, were also likely analyzed in this laboratory area. A 6-inch drain line exited the laboratory to a 'dry well' located approximately 100 feet from the southeast corner of the building (laboratory wastes may have been directed to this dry well). A second laboratory area was potentially located in the northwest corner of the Change House (the nature of work conducted in this laboratory is not known).

2.2 Previous Investigations

Previous investigations and reports that include a discussion of the Process Areas and provide background information for this draft RAP are listed below, generally in chronological order, including several documents that were summarized and referenced in the Radiological Data Compilation for the Site (Brown and Caldwell, 2005):

- Bureau of Land Management, Carson City Field Office, 2004, BLM Yerington Mine Health and Safety Plan. Site health and safety plan prepared for BLM employees working at the Yerington Mine Site. The health and safety plan included an Appendix that summarized radiological survey results in the Process Areas and identified several areas with elevated gamma radiation. Soil samples were collected and analyzed in several areas.
- Technical Resources Group, 2005, Review of Yerington Mine Characterization Activities. Consultant report prepared for BLM Nevada State Office for the purpose of checking radiation activity levels and soil chemistry in the previously identified areas in the Process Areas and other areas of the Site. The report identified a disequilibrium in uranium daughter products that may have resulted from ore beneficiation.

- U.S. Environmental Protection Agency, 2005, EPA Radiation and Indoor Environments National Laboratory Scanner Van Survey of the Yerington Mine Site and Surrounding Areas. A technical memorandum summarizing the data results of the scanner van radiological survey in the Process Areas and other areas on and off the mine site. Results confirmed the presence of the elevated radiological areas identified by BLM and did not find any new radiological areas in the areas covered by the survey.
- Brown and Caldwell, 2005, Data Summary Report (DSR) for Process Areas Soils Investigation. Consultant report prepared for ARC, summarizes the analytical results of 550 soil samples collected in the Process Areas in 2004 and 2005. Surface and subsurface sampling was conducted around ore beneficiation components, ancillary buildings, underground pipelines, electrical transformers, and areas of hydrocarbon stained soil.
- Rocky Mountain Environmental Consultants, 2005, Final Radiological Monitoring Report, October 2004 to April 2005, Yerington Mine Site Investigation Operations. Consultant report prepared for ARC summarizes the results of radiological health and safety monitoring in the Process Areas during field sampling activities. Includes some fugitive dust air samples collected during ground disturbance activities.

Two previous investigations provide the specific framework for this draft RAP: 1) the 2004-2005 remedial investigation program, which characterized soil conditions (Brown and Caldwell, 2005); and 2) the START Report prepared by EPA (2008).

2.2.1 Process Areas Soils Investigation

As described in the *Data Summary Report for Process Areas Soils Characterization* (Brown and Caldwell, 2005), a total of 1,129 surface and borehole grab soil samples were collected to a depth of 25 feet bgs from 319 locations in the Process Areas. Most of the soil sample locations targeted specific ore beneficiation components such as buildings, tanks, pumps, and ditches to evaluate areas most likely to be affected by activities associated with ore beneficiation (e.g., solution conveyances, drains, sumps or piping). In addition, grid sampling of a targeted portion of the Process Areas was also conducted. Samples were analyzed for metals, total petroleum hydrocarbons (TPH), volatile and semi-volatile organic compounds (VOCs and SVOCs), acid-base potential (ABP), pesticides, herbicides and polychlorinated biphenyls (PCBs). These data, in addition to the chemical analyses presented in the START Report (Section 2.2.2), provide the basis for documenting the character of the TENORM waste to be removed from the Site.

Analytical results for metals and radionuclides are presented in Appendix A in the form of tables and maps for the following Process Areas that include the areas of TENORM waste subject to this draft RAP:

- Area 3 - Leach Vats
- Area 4 - Solution Tanks,
- Area 5 - Precipitation Plant (i.e., iron launders)
- Area 10 - North Low Area (including the low bermed area)

2.2.2 START Assessment

The 2008 START Report, provided as Appendix B, describes an assessment performed in 2007 by EPA to characterize the extent of radiological contamination in surface soils within the Process Areas (data validation reports included as Attachment 3 in the START Report were not made available by EPA). Table 2 of the START Report shows that the highest concentrations of radium-226, which ranged from 705 to 1,080 pCi/g, were reported from sample locations along the southwest side of the precipitation plant where sumps, pumps, piping and a dry well were located. Analytical results for soil samples collected during the radiation assessment resulted in an action level of 3.79 pCi/g of radium-226, which represented the sum of the average radium-226 background concentration (1.21 pCi/g) and the preliminary remediation goal (PRG) for an outdoor worker (2.58 pCi/g). Subsurface samples indicated limited radiological contamination at depth in the Process Areas, as indicated in Table 3 of the START Report.

The assessment also included hand-held and Environmental Radiation Ground Scanner (ERGS) gamma surveys. The hand-held instrument was equipped with 3-inch by 3-inch sodium iodide (NaI) detectors assessed measured gamma radiation levels relative to two- and five-times the detector background of 16,000 counts per minute (cpm). Figure 9 of the START Report illustrates background areas (green) and areas of potential and high-priority contamination (yellow and red, respectively, approximately 2x and 5x background). The ERGS gamma survey assessed measured gamma radiation levels against a threshold of 20,828 cpm, which was considered approximately equal to the site-specific radium-226 action level of 3.79 pCi/g.

SECTION 3.0
DELINEATION AND SURVEYS OF TENORM WASTE AREAS

Pursuant to the June 16, 2010 meeting and subsequent discussions on the extent of the TENORM waste subject to this draft RAP, ARC and EPA agreed on June 18, 2010 (via e-mail exchanges) to the delineated areas shown on Figures 3-1 and 3-2 that include locations where the START Report identified concentrations above the action level of 3.79 pCi/g of Ra-226 and ERGS-indicated clusters with count rates in excess of 20,829 cpm (i.e., isolated detected count rates in excess of 20,829 cpm were not included). Universal transverse mercator (UTM) coordinates for the survey and sample locations in the START Report were converted to State Plane NAD 29, NVGD 1927 coordinates using survey control data at the Site to prepare Figures 3-1 and 3-2 and to stake area perimeters.

Seventeen areas around the leach vats, solution tanks and precipitation plant (i.e., precipitation plant areas shown on Figure 3-1) have been delineated, which will be excavated to a depth of three feet bgs. Figure 3-1 also shows START soil sampling locations that exceed the 3.79 pCi/gram of Ra-226 action level. The areas shown in Figure 3-1 will be staked in the field by a Nevada-registered surveyor to establish the staked perimeters, which will be available for EPA's review prior to the removal action. The surveyed perimeters will also define the elevation of these areas in order to establish the post-construction excavation depth for each area, to ensure that the three-foot thickness has been removed.

TENORM waste within the dump leach surge pond will be excavated to a depth of two feet bgs. The topography of the impacted soils within the dump leach surge pond will be surveyed on a 15-foot by 15-foot grid prior to the removal action to establish floor elevations within the pond. Given that the base of the berm within the pond (Figure 3-2) will serve as the perimeter for the excavation, no perimeter staking within the surge pond will be performed prior to the removal action. A post-excavation survey will also be performed to ensure that the required two-foot thickness of impacted soils from the dump leach surge pond has been removed.

SECTION 4.0
IMPLEMENTATION PLAN

This section describes the implementation of the removal action including material quantities, excavation equipment, dust control requirements, air monitoring, equipment decontamination and associated project execution activities. Excavations may be enlarged, as necessary, for equipment access or to leave a post-excavation graded condition that will ensure Site health and safety concerns. Given that this removal action only addresses impacted soils designated as TENORM waste, the excavations will exclude any non-soil materials (e.g., the concrete-lined pipe trench between the solution transfer tanks and the precipitation plant). As indicated in Section 1.3, remaining portions of the Process Areas containing radiological waste will be subject to future remedial investigations and feasibility studies.

4.1 Material Quantities

The total estimated volume of 3,700 cubic yards of impacted soils subject to the removal action was calculated using AutoCAD 2008 software and delineating the areas to be removed with a 2D polyline to obtain a square-foot area for each of the excavations. Based on the 3-foot thickness of TENORM waste within the 17 small excavations in the precipitation plant area, the volume of soils to be removed is approximately 1,020 cubic yards. Based on the 2-foot thickness of TENORM waste within the internal perimeter of the dump leach surge pond (Figure 3-2), the volume of soils to be removed is approximately 2,680 cubic yards. These material quantities were calculated by: 1) multiplying the square footage of each area to be excavated by the depth of removal (2- or 3-feet, depending on location); and 2) dividing by 27 to obtain the volume of each area in cubic yards. ARC will provide EPA with a final total of excavated cubic yards of TENORM waste removed from the Site in the Removal Action Report.

4.2 Project Execution

The following information has been developed to outline the approach anticipated by ARC for the radiological materials removal action. Figure 4-1 depicts the removal action work areas. Some aspects of this approach may be modified by the selected contractor following ARC's procurement process. For example, the removal action construction methods and ARC-suggested equipment (i.e., means and methods) described below may be modified by the selected contractor. Similarly, modifications to the dust control plan described below may be suggested by the selected contractor. Any such modifications that are consistent with the project execution approach will be presented to EPA for approval prior to the start of work.

4.2.1 Geotechnical Characterization

ARC will conduct a limited geotechnical characterization of the soils within the dump leach surge pond to assess their load capacity with respect to the type of excavation equipment and trucks that can operate within the pond. The characterization will consist of visual grain size analysis American Society of Testing and Materials (ASTM D 2488) and laboratory nuclear density gauge testing for moisture and field dry density (ASTM D 2922). If the soils are determined to be fine grained, a Pocket Penetrometer will be used to qualitatively estimate shear resistance. These tests will aid the contractor in final equipment selection and the estimation of the number of loads required for transport to the off-Site repository.

4.2.2 Construction Water

The radiological materials removal action will require construction water for dust suppression during excavation and loading. Previous removal actions used water from the Tibbals Well, located south of Burch Drive (Figure 4-1). The contractor will be required to make the necessary improvements to access the Tibbals Well and provide locations for temporary storage tanks, if needed. ARC will work with the contractor, as needed, to facilitate access to this water supply source.

4.2.3 Excavation and Loading

Excavation of the TENORM waste from the precipitation plant areas and from the dump leach surge pond will occur sequentially to optimize the placement of all soils into trucks for conveyance to the off-Site repository. Soils excavated to a depth of three feet bgs from the seventeen discrete precipitation plant areas (Figure 3-1) will be placed within the dump leach surge pond on 'stockpile area', shown on Figure 4-2. ARC anticipates that the soils from these discrete excavations will require a relatively small excavator (e.g., Caterpillar 318), skid steer loader for tight spaces, if required, and a small dump truck (i.e., 5- to 8-yard capacity). Upon completion of the discrete excavations and ARC verification of the target removal depth of three feet bgs, ARC will discuss with EPA the approach to stabilizing these excavated areas with respect to potential dust generation, and grading the excavations. Equipment used for the removal of soils from these small excavations will be surveyed for radiological contamination and, as necessary, decontaminated prior to demobilization from the Site (see below).

Prior to excavating the precipitation plant area soils, access ramps will be constructed in the southeast-facing and northwest-facing berms of the pond at a grade not-to-exceed four percent (Figure 4-2). These ramps will include a 12-inch top layer of Type II Aggregate Road Base from the Rocks Road Pit in Yerington, Nevada to provide access for the 22-ton haul trucks. The imported aggregate will be compacted to provide an all-weather access road as shown on the plan sheets. The aggregate will be tested to ensure that it does not exceed the Site radiological threshold.

The access ramps will provide access for excavation equipment and haul trucks into and out of the pond, and support a one-way traffic pattern for haul trucks. Once all of the excavated soils from the precipitation plant areas have been placed into the dump leach surge pond, the contractor will initiate the removal of the TENORM waste subject to this draft RAP to the off-Site repository.

After the soils from the precipitation plant areas are placed in the 'stockpile area' of the dump leach surge pond, the 2-foot depth of TENORM waste from the pond will be excavated, along with the soils from the discrete areas described above, using a medium-size rubber-tired front end loader (e.g., Caterpillar 962). This loader will also load the haul trucks with TENORM waste for transport to the off-Site repository (Section 4.3). ARC will verify the removal depth and, pending further discussions with EPA, the excavated pond will be stabilized with respect to dust generation. Once all the designated TENORM waste in the pond have been removed, the equipment used for the removal action will be surveyed for radiological contamination and, as necessary, decontaminated prior to demobilization from the Site. Haul trucks will be surveyed for external radiological contamination (tires, chassis, bed exterior, etc.) and decontaminated as necessary prior to leaving the Site with each load.

Equipment contamination surveys will be performed on the exit ramp from the dump leach surge pond as close as practicable to the surge pond where background radiation levels are low enough to permit the contamination surveys. A Ludlum Model 43-89 alpha/beta probe (or equivalent) connected to a Ludlum Model 2224 meter (or equivalent) will be used to perform the average and fixed contamination surveys. Contamination will be measured on 100 square centimeter (100 cm^2) swipes using a Ludlum 3030E (or equivalent) meter. Swipe locations will include potential areas where contamination may accumulate contamination (e.g., tires, tracks, buckets, chassis, etc.) based on the professional judgment of the health physicist/surveyor performing the surveys.

Acceptable release limits (Table 4-1) are based on the release criteria for the State of Nevada (Eric Matus, Nevada Department of Human Health Services; pers. comm.; July 6, 2010), which are consistent with the NUREG 1.86 limits for uranium and uranium decay products established by the U.S. Atomic Energy Commission (USAEC, 1974). Fixed and removable contamination limits are based on measuring the fixed and removable contamination as disintegrations per minute (dpm) on $100cm^2$ of the surface of the object. The average contamination release level is based on averaging the measured fixed contamination levels over one square meter.

Table 4-1. Acceptable Surface Contamination Levels			
Criteria	Average	Fixed	Removable
Limit	5,000 dpm/100cm^2	15,000 dpm/100cm^2	1,000 dpm/100cm^2

Equipment decontamination will be performed in the dump leach surge pond and/or on the exit ramp from the dump leach surge pond. Although ARC anticipates dry decontamination methods (wiping and brushing) will be sufficient for the decontamination of the haul trucks used to convey the TENORM waste to the off-Site repository, pressure spray washing will be conducted if required to achieve the . Dry decontamination may also suffice for rubber-tired excavation equipment. Tracked excavation equipment is expected to require wet decontamination methods. Wet decontamination will be performed within the perimeter of the dump leach surge pond and will be performed using pressure-washing equipment to minimize the volume of water generated.

4.2.4 Debris Management and Post-Excavation Conditions

Excavation of the TENORM waste from the precipitation plant areas and from the dump leach surge pond may encounter miscellaneous debris that may or may not meet the action level applicable to the soils to be excavated and removed from the Site. Such debris will be managed in a 'debris stockpile area' to be determined by the contractor, and subject to approval by EPA. This 'debris stockpile area' will be located out of the anticipated work areas and traffic patterns associated with this removal action and routine access within the Process Areas.

Post-excavation conditions associated with the precipitation plant areas and the dump leach surge pond will be addressed after the TENORM waste has been removed from the Site in consultation with EPA. Potential options for managing these areas from a dust mitigation and/or Site health and safety perspective include one or more of the following activities discussed with EPA during the June 16th meeting: regrading, backfilling, application of surface sealant(s) and institutional controls (e.g., signage, bollards or posts with tape).

4.3 Off-Site Waste Repository

All excavated materials will be shipped to US Ecology's Grand View, Idaho facility, which is licensed to accept Resource Conservation and Recovery Act (RCRA) and (TE)NORM wastes and has an existing contractual relationship with ARC. ARC anticipates approximately 280 round trips between the Site and the Grand View, Idaho facility based on the estimated number of cubic yards, a conservative tonnage factor of 1.66 tons per cubic yard, and a fleet of 18-wheel tractor-trailers with 22 tons of haul capacity.

Copies of the waste acceptance criteria and addendum for the US Ecology facility are provided in Appendix C. The waste profile form requires that the waste stream source, characteristics and composition be specified. These specifications will be supported by providing the analytical results from the initial Process Areas soils investigation (Brown and Caldwell, 2005) and the 2008 START Report. For radioactive materials, a Waste Acceptance Criteria Addendum is also required (Appendix C). This addendum is designed to ensure that the waste stream complies with the facility's radioactive material waste acceptance criteria. For this removal action, the US Ecology facility is limited to wastes containing less than the concentrations given in Table 4-2.

Table 4-2. US Ecology Idaho Select Radioactive Waste Acceptance Criteria

Radionuclide	Maximum Concentration
Natural uranium	<500 ppm (167 pCi/g U-238)
Natural thorium (Th-232 + Th-228)	<500 ppm (110 pCi/g)
Ra-226 + Ra-228	<500 pCi/g
Pb-210	<1500 pCi/g
All radionuclides present*	<2000 pCi/g

* Sum of concentration of all radionuclides present, parent and progeny radionuclides

The START Report indicated that analytical results for Pb-210 were non-detects for all but two samples, both of which were qualified ("J" flag) results. The soils investigations performed by ARC did not analyze for Pb-210. Pb -210 has a 22.6 year half-life and is assumed to be present in concentrations in excess of background levels only as a result of in-growth from Ra-226.

However, due to the relatively long half-life of Pb -210, over a hundred years would be required for equilibrium to be established, which is a much longer time frame that has been available for the build-up of decay product concentrations. The investigation results presented in the START Report did not detect Pb-210, which indicates that Pb-210 is only present in concentrations equal to decay equilibrium with background levels of uranium (i.e., Pb-210 is in assumed to be in equilibrium with the uranium concentration in the samples).

START Report analytical data are available for eight excavation locations, including the two largest areas shown on Figure 3-1 (the 'Radiological Control Area' or RCA adjacent to the precipitation plant and an area south of the solution transfer tanks, which is the location of sample SS-39), and the dump leach surge pond (Figure 3-2). These biased sample locations will result in an overestimate of actual concentrations within each area.

Process Areas soils data (Brown and Caldwell, 2005) that include radionulcides, metals and hydrocarbons results within or adjacent to the excavation areas are provided in Appendix A. Figure 4-3 shows sample locations with soils data to be used to support the waste acceptance criteria for the US Ecology facility. The dump leach surge pond soils constitute 72 percent of the total volume (2,680 cubic yards) and are fully characterized by averaging ARC and START Report analytical results (START samples SS-7, SS-8 and SS-9 and ARC samples PA-KK1, PA-KK2 and PA-KK3).

Non-radiological characterization (for metals and hydrocarbons) will be based on an average of the three ARC samples due to the random method used to select the sample locations. For the large area adjacent to the precipitation plant shown in Figure 3-1 (i.e., the RCA), approximately 451 cubic yards, or 12 percent of the total volume, will be characterized in a similar manner using sample locations SS-33 and SS-35 from the START Report and ARC sample locations PA-EE8, PA-EE18 and PA-EE17.

For the remaining locations (570 cubic yards or 15 percent of the total volume): nine are associated with the solution transfer tanks, four are associated with the precipitation plant, and three occur between the precipitation plant and solution transfer tanks. START Report data is available for 6 of these locations (sample locations SS-30, -32, -36, -37, -38, and -39) and ARC data is available for 3 locations (sample locations PA-DD5, PA-DD12, and PA-FF3).

The radionuclide concentrations will be based on an area-weighted average of the concentrations from the combined ARC and EPA data. Locations with no data are assumed to be similar to the area-weighted average for locations with data. Sample locations PA-DD4, PA-DD6, PA-DD11, PA-EE6, PA-EE14, PA-EE16, PA-FF1, PA-O1, PA-O2, PA-O3, PA-UT14, and PA-UT53 address metals and hydrocarbons. These locations are sufficiently close to areas being excavated and should exhibit similar metals and hydrocarbons contamination levels.

Using this approach, the radionuclide concentrations of the waste stream are given in Table 4-3 (progeny are assumed to be present in equilibrium down to the next listed radionuclide).

Table 4-3. Waste Stream Radionuclide Concentrations

Radionuclide	Concentration (pCi/g)
Dump Leach Surge Pond	
U-238	4.0
Th-232	0.4
Ra-226 + Ra-228	37.4
Pb-210	4.0
Total, all progeny	344
RCA	
U-238	11.9
Th-232	5.9
Ra-226 + Ra-228	390
Pb-210	11.9
Total, all progeny	2517

Table 4-3. Waste Stream Radionuclide Concentrations	
Radionuclide	**Concentration (pCi/g)**
Other Areas	
U-238	13.4
Th-232	42.1
Ra-226 + Ra-228	167
Pb-210	13.4
Total, all progeny	1167
Overall Averages	
U-238	6.4
Th-232	7.5
Ra-226 + Ra-228	100
Pb-210	6.4
Total, all progeny	735

4.4 Dust Control and Air Monitoring

Fugitive dust control measures and associated air quality and meteorological monitoring will be implemented as part of this removal action. The following dust control plan and monitoring requirements may be modified by the selected contractor. Contractor-suggested modifications will be submitted to EPA for approval prior to the start of field activities.

4.4.1 Dust Control Plan

The dust control plan will prevent/minimize fugitive dust during removal action activities that have the potential to generate dust such as earthwork (e.g., excavating, loading/unloading and grading) and vehicle transportation on Site roadways. Removal action activities will not be conducted during periods of high winds (i.e., greater than 25 miles per hour [mph]). Conditions such as high winds, low relative humidity and long periods of no precipitation may result in fugitive dust. Because the removal action is expected to occur in late summer, when one or more of these ambient conditions typically occur, dust control measures will include:

- Applying water to suppress dust;
- Minimizing vehicle speed (i.e., less than 25 mph) on haul roads; and
- Tarping, dry-brushing, or cleaning vehicles.

A water truck will be used full time during the removal action to spray water on the excavation areas, earthwork equipment, haul truck beds and haul roads. The water will be applied such that it will moisten materials/objects that may create fugitive dust, and not puddle or create run-off. If notification levels discussed below are exceeded, additional physical or chemical dust suppressants, dust palliatives and/or measures will be applied to suppress fugitive dust.

4.4.2 Air Monitoring Plan

A combination of project work area monitoring and Site perimeter monitoring will be conducted to: 1) evaluate the effectiveness of fugitive dust control measures; 2) establish a notification procedure for when additional dust control measures or modifications to work practices may be necessary; and 3) document concentrations of chemicals and radionuclides at the perimeter of the Site. Planned air monitoring locations are shown on Figure 4-4.

Project Work Area Air Monitoring

Air quality monitoring in the immediate area of the removal action work activities will be conducted to evaluate the effectiveness of fugitive dust control measures. Seven temporary air monitoring stations (PA-1 through -7) will be located surrounding the removal action work areas. The rationale for these locations is summarized below:

- PA-1: located between the middle of the Leach Vats and Solution Tanks. This location monitors fugitive dust that may be generated from earthwork activities near the eastern portion of the Solution Tanks. This location also serves as a typical upwind location for the removal action area.
- PA-2 through -5: located along the perimeter of the Solution Tanks/Precipitation Plant removal area. These locations monitor fugitive dust that may be generated from earthwork activities throughout the Solution Tanks/Precipitation Plant area. These locations can also serve as downwind locations for the removal action area for multiple wind directions.

- PA-6 and -7: located south (PA-6) and northeast (PA-7) of the W-3 Dump Leach Surge Pond. These locations monitor fugitive dust that may be generated from earthwork activities near the surge pond. These locations can also serve as downwind locations for the removal action area for multiple wind directions.

ARC will analyze wind patterns daily at AM-3 to identify the likely predominant wind direction for the following construction day. Based on this assessment, one upwind station and two downwind stations will be used, so that three of the seven stations are active at any one time. Each of the three stations will be equipped with a PM10 meter and radionuclide sampler described below (the data will be provided to EPA on a weekly basis during the removal action):

- PM10 Meter: the real-time PM10 meter will provide 15-minute measurements for 8 core hours of the construction day. The meter will be a Thermo Electron aDR-1200S Ambient Particulate Monitor (or equivalent) that features a tripod, a rechargeable battery pack, a real-time display, a data logger, a programmable PM10 Notification Level, and a visual/audible alarm system. Operation and calibration of the meter will be conducted per the manufacturer specifications. The monitors are calibrated at the factory prior to shipment and will be zeroed prior to each day of operation. The meter will be positioned approximately 2 meters above ground surface at each location.
- Radionuclide Sampler: radionuclide samples will be collected using an F&J Specialty Products DF-40L-Li battery-powered pump (or equivalent) using a 2 inch filter at a minimum flow rate of 30 liters per minute (lpm). Operation and calibration of the pumps will be conducted per the manufacturer specifications. The pumps are calibrated at the factory prior to shipment. The air intake will be positioned approximately 2 meters above ground surface at each location. The batteries will be recharged overnight. Samples will be collected twice a day, on days when excavation is occurring, with a minimum sample collection time of 4 hours for each sample. The samples will be analyzed daily on site using a Ludlum Model 3030E Alpha/Beta sample counter so that appropriate action can be taken for the following construction day.

Combining real-time monitoring with notification levels provides the contractor with a real-time numerical method to evaluate the effectiveness of fugitive dust control measures and the ability to quickly determine when the measures need to be increased or when removal action activities need to be modified to control dust. Notification levels for the field effort are provided in Table 4-4 along with the corresponding field responses and personnel notifications.

Table 4-4. Notification Levels for Evaluating Fugitive Dust Control Effectiveness

Notification Level	Level 1	Level 2	Level 3
PM10 Concentration (15-min average)	0.5 mg/m^3	1.0 mg/m^3	2.5 mg/m^3
Radionuclide Concentration (4-hr average)	---	---	0.003 pCi/l Gross Alpha 0.51 pCi/l Gross Beta
Construction Contractor Response	Increase fugitive dust control measures.	Increase fugitive dust control measures.	Stop work temporarily. Increase fugitive dust control measures and/or modify work practices.
Construction Manager Response	Visually monitor meter display to verify PM10 concentration falls below Level 1.	Visually monitor meter display to verify PM10 concentration falls below Level 1.	Meet with Construction Contractor to discuss additional measures and/or modified work practices. Visually monitor meter display to verify PM10 concentration falls below Level 2.
Personnel Notification	Construction Contractor, ARC Project Manager.	Construction Contractor, ARC and EPA Project Managers.	Construction Contractor, ARC and EPA Project Managers. Approval from ARC and EPA Project Managers is required to resume work.

Either of the PM10 or radionuclide notification levels can trigger the response (i.e., they do not have to occur concurrently), as described below:

- PM10 Notification Level: although the PM10 Notification Levels are based on a 15-minute average PM10 concentration beginning with 0.5 milligrams per cubic meter (mg/m^3), the visual/audible alarm system will be programmed for an instantaneous PM10 measurement of 0.5 mg/m^3 to indicate that construction activities may be generating excessive dust in a localized area. If a 15-minute measurement of PM10 equals or exceeds 0.5 mg/m^3 at one or more stations, the contractor must notify the ARC Project Manager and implement additional dust control measures so that the following 15-minute measurement of PM10 falls below 0.5 mg/m^3. If a PM10 measurement equals or exceeds 1.0 mg/m^3, the EPA will be notified. If a PM10 measurement equals or exceeds 2.5 mg/m^3 at one or more stations, work activity will be suspended until the cause of dust is determined and the appropriate dust control measures are implemented and/or work practices are modified.
- Radionuclide Notification Level: since a Ludlum Model 3030E only measures gross alpha and gross beta concentrations, the radionuclide-specific Notification Levels are expressed as 4-hour average gross alpha and gross beta concentrations. The Notification Levels were derived using the average radionuclide air concentration limits (see below for additional details). The samples will be analyzed daily and used to evaluate the need for modified dust control measures for the subsequent day. If a 4-hour average gross alpha concentration exceeds 0.003 picoCuries per liter (pCi/l) or gross beta concentration exceeds 0.51 pCi/l, work activity will be suspended until the cause of dust is determined, appropriate dust control measures are implemented, and/or work practices are modified.

Actions taken to limit other hazards associated with PM10 dust will also minimize radiological exposure hazards. The objective of the air monitoring is to limit occupational exposure to less than 500 millirem (mrem) per year, 10 percent of the applicable Occupational Safety and Health Administration (OSHA) limit of 5 roentgen equivalent man (rem) per year. Accordingly, airborne radionuclide concentrations will be monitored to ensure they remain below 10 percent of the Derived Air Concentrations (DACs) specified in 10 Code of Federal Regulations (CFR) 20 [Appendix B; Table 1; Column 3}. Site-specific air concentration limits are provided in Table 4-5.

Table 4-5. Radionuclide Air Concentration Limits

Radionuclide	Air concentration limit
Radionuclide Specific Limits:	
Ra-226	0.03 pCi/l
Ra-228	0.05 pCi/l
Natural uranium	0.002 pCi/l
Th-232	5E-5 pCi/l
Field Measurable Limits:	
Gross alpha	0.003 pCi/l
Gross beta	0.51 pCi/l

Because the Ludlum Model 3030E only measures gross alpha and gross beta concentrations, the radionuclide-specific air concentration limits in Table 4-5 are converted to gross alpha and gross beta concentration limits using the average and total radionuclide concentrations in Table 4-4. This results in a gross alpha concentration limit of 0.003 pCi/l, using a sum-of-fractions approach to address Ra-226, uranium, and Th-232 air concentration limits, and a gross beta concentration limit of 0.51 pCi/l, using a sum-of-fractions approach for the Ra-228 air concentration limit.

<u>Perimeter Air Monitoring</u>

Three of the perimeter air monitoring stations (AM-1, AM-3, and AM-4) used in the three-year air quality monitoring program (AQM, Brown and Caldwell, 2009a) will be re-commissioned to document the concentrations of chemicals at the perimeter of the Site during the removal action.

These stations were selected because they are located upwind (AM-1) and downwind (AM-3 and AM-4) of the project work areas along the predominant wind direction at the Site (i.e., from southwest to northeast when wind velocity is greater than 10 mph). A combination of high volume air samplers, a continuous particulate monitor and a meteorological station will be used, as summarized in Table 4-6.

Each station will be equipped with a high volume air sampler that will collect a filter sample for analysis of PM10, sulfate, eight metals (aluminum, arsenic, cadmium, chromium, cobalt, copper, manganese, and nickel), and five radionuclides (Gross Alpha, Ra-226, Ra-228, Th-228, and Th-230). The high volume air samplers will be the same as those used in the 3-year air quality monitoring program: the Tisch Environmental TE-6070D High Volume PM10 monitors with EPA Federal Reference Method (FRM) designation RFPS-0202-141. High volume samples will be collected before and during the removal action.

Table 4-6. Summary of Perimeter Monitoring Equipment and Operation

Equipment	Station(s)	Operation
High Volume PM10 Air Sampler	AM-1, AM-3, and AM-4	Collect samples at all 3 stations: on 2 events prior to start of earthwork activities (background conditions), daily during first week of full-scale operations (startup period); and weekly thereafter (construction period). Additional samples collected if Notification Level 3 exceeded at any time.
Continuous Particulate Monitor	AM-3	Continuously measure PM10 concentration during construction activity. Download data daily and if any 1-hour average concentration exceeds 300 $\mu g/m^3$, notify both the ARC and EPA Project Managers.
Meteorological Monitoring	AM-3 and AM-6	Continuously measure 15-minute wind speed and direction during construction activity at AM-3 and AM-6. If any 15-minute average wind speed exceeds 25 mph at AM-3, temporarily stop work until wind speed falls below this level. Continually measure ambient temperature, relative humidity, barometric pressure, precipitation, and solar radiation at AM-6.

To establish background conditions, an 8-hour high volume sample will be collected from all three monitoring locations on two occasions prior to the start of earthwork activities. To evaluate concentrations of chemicals at the perimeter of the Site during the startup of the removal action, an 8-hour high volume sample will be collected daily from all three monitoring locations during the first week of full-scale operations. For the remainder of the construction period, an 8-hour high volume sample will be collected on a weekly basis from all three monitoring locations.

The duration of these startup and weekly samples will coincide with the core daily construction activity, which is estimated to be between 8 and 10 hours, and sampling will be designated on random days during the construction week. Additional samples will be collected if Notification Level 3 is exceeded at any time. Station AM-3 will also be equipped with a continuous particulate monitor capable of providing 15-minute PM10 measurements continuously throughout the construction activity. The real-time air sampler will be the same as that used in the 3-year air quality monitoring program: the Thermo Scientific TEOM Series 1400a Ambient Particulate Monitor with FRM designation EQPM-1090-079.

Meteorological Monitoring

Meteorological parameters will be monitored continuously during the removal action using equipment at AM-3 and AM-6. Meteorological data will be used to interpret the perimeter air monitoring data and monitor wind speeds during the removal action. Wind sensors at AM-3 and AM-6 will provide continuous 15-minute average measurements of wind speed and direction. If any 15-minute average wind speed at AM-3 (the location closest to the removal action activity) exceeds 25 mph, the contractor will temporarily stop work until the wind speed falls below this level. The meteorological station at AM-6 will also provide continuous measurements of ambient temperature, relative humidity, barometric pressure, precipitation, and solar radiation.

Air Monitoring Data Quality

Quality control procedures will include:

- Standard operating procedures for equipment operation, maintenance, and calibration;
- Quarterly maintenance and calibration of high volume air samplers and the continuous particulate monitor;
- Semi-annual maintenance and calibration of all meteorological equipment;
- Filter blanks and field blanks for high volume air samples;
- Laboratory quality control samples consisting of method blanks, laboratory control samples, and laboratory duplicate samples as specified in the Quality Assurance Project Plan - Revision (QAPP; ESI and Brown and Caldwell, 2009); and
- Data verification, validation, and management.

SECTION 5.0
HEALTH AND SAFETY REQUIREMENTS

All field activities will be conducted in accordance with the Site Health and Safety Plan (HASP; Brown and Caldwell, 2009b). The HASP identifies, evaluates and prescribes control measures for health and safety hazards, including radiological hazards, and describes emergency response procedures for the Site. HASP implementation and compliance is the responsibility of Brown and Caldwell, with ARC taking an oversight and compliance assurance role. Copies of the HASP are located at the Site and are available to all Site workers. The HASP includes site specific requirements and procedures including:

- Safety and health risk or hazard analysis;
- Employee training requirements;
- Personal protective equipment (PPE);
- Daily safety meeting requirements;
- Medical surveillance;
- Site control measures (including dust control);
- Decontamination procedures; and
- Emergency response.

ARC will develop a project specific Health Safety, Security and Environmental (HSSE) prior to the start of work that will identify all project specific health and safety requirements, including:

- Scope with estimated dates and duration of activities;
- Assigned roles and responsibilities and specific training requirements;
- Development and maintenance of task safety and environmental analyses (TSEAs);
- Communications plan;
- Simultaneous operations (SIMOPS) plan;
- Traffic control plan;
- Identification of control of work permitted activities; and
- List of associated safety work risk assessments (WRA).

5.1 Training

All Site workers and contractors will receive applicable training, as outlined in 29 CFR 1910.120(e), and as stated in the HASP and Project HSSE Plan. Site-specific training will be covered at the pre-entry briefing, with an initial Site tour and review of Site conditions and hazards. Records of pre-entry briefings will be maintained at the project site. Planned training elements include:

- Persons responsible for site-safety;
- Site specific safety procedures;
- Site-specific safety and health hazards;
- Project and task specific work risk assessment and mitigation;
- Use of PPE;
- Decontamination procedures; and
- Emergency response procedures.

Other required training, depending on the particular activity or level of involvement, includes Occupational Safety and Health Administration (OSHA) 40-hour training and annual 8-hour refresher courses. Other training may include, but is not limited to, competent personnel training for excavations and confined space. Copies of Site personnel OSHA certificates will be maintained at the Site and in employee personnel records.

5.2 Personal Protective Equipment

Minimum PPE requirements required for removal action activities include:

- hard hat;
- safety glasses;
- steel-toe boots;
- long-sleeve shirts;
- high-visibility clothing or reflective vest; and
- nitrile and/or leather work gloves (as needed).

Additional PPE may be required depending on the work task and may include, but is not limited to Tyvek coveralls, respirators, rubber boots, and/or hearing protection. The specific PPE requirements will be identified in the project risk assessment documents and HSSE Plan and may be modified based on site conditions.

5.3 Construction Related Health and Safety Procedures

Health and safety issues related to construction activities include ground disturbance, airborne dust and vehicle traffic. A variety of heavy equipment will be used including excavators, haul trucks, or other equipment. Precautions shall be taken to ensure equipment is selected and used properly and is operated by qualified and trained operators.

5.3.1 Ground Disturbance

All excavations or other activities that result in ground disturbance must be evaluated for potential buried utilities that could interfere or create a safety hazard and shall be evaluated for potential utilities and pipelines through utility location procedures and ground disturbance permits issued by Brown and Caldwell to the contractor.

5.3.2 Dust Control and Air Monitoring

Dust will be generated during the loading and hauling activities. The dust source may contain elevated levels of some metals, however, the metals concentrations are not expected to be at hazardous levels or to exceed OSHA permissible exposure levels (PEL). Air monitoring will be conducted as described in Section 4.4.2.

If these action levels are exceeded, dust control measures will be implemented. Workers are not expected to be required to wear any level of respiratory protection; however, if monitoring identifies an inhalation concern, respirators may be required in select areas. If respirators are required for any workers, Brown and Caldwell’s respiratory protection program requirements shall be followed including medical evaluation of each worker and fit testing and training on the use of respirators.

5.4 Radiation External Dose Monitoring

All personnel working in the vicinity of the excavations or involved with the oversight of the activities in this work plan shall be issued a personal radiation monitoring device. However, workers that will be in the removal areas only briefly, such as the highway truck drivers or surveyors, will not be issued a personal radiation monitoring device because their potential exposure will be limited. Personnel monitoring devices worn will be thermoluminescent dosimeters (TLD) or optically stimulated luminescent dosimeters (OSLD). The site HASP requirements for the use and issuance of personal monitoring devices shall be followed.

5.5 Traffic Control

A traffic control plan, to be included in the Project HSSE Plan, will be established at the start of the removal action by the selected contractor to define access routes that trucks and equipment are allowed to use (or are excluded from), designated directions of travel, areas limited to one-way traffic and traffic management procedures for areas with two-way traffic or intersections. During the removal action, daily traffic control plans will be communicated to any other on-Site personnel conducting unrelated work to avoid potential simultaneous operations (SIMOPS) complications/conflicts. Traffic control on public roadways will not be required.

5.6 Work Risk Assessment

Work Risk Assessment (WRA) is a risk management tool for the identification and ranking of hazards associated with all aspects of a specific job before and after implementation of risk controls and preventive actions. Control of the hazards can be accomplished by elimination or substitution of the task, isolation of Site workers from the hazard, use of engineering or administrative controls, and/or the use of PPE. The WRA for the removal action described in this draft RAP is provided in Appendix D and is subject to modification at any point before or during the implementation of work activities. A summary of potential hazards associated with the removal action activities described in this draft RAP is provided in Table 5-1.

Detailed TSEAs will be created for each of the individual tasks that comprise the removal action prior to implementation of the work. TSEAs are similar to job safety analyses (JSAs), but include potential risks to the environment. Comprehensive TSEAs will be completed for all field tasks required for the removal action before the work is initiated and will be developed jointly by the field staff conducting the work and the Project Safety Manager. TSEAs will be kept at the Site at all times and will be reviewed by Site workers prior to, and throughout, the removal actions in order to identify new hazards or controls.

Table 5-1. Work Risk Assessment Summary1

Field Activities	Potential Hazards
Survey and mark out excavation areas; conduct utility location survey.	▪ Physical hazards of walking around debris, abandoned equipment, open/unprotected basements & tanks
Road improvements and preparation of temporary stockpile location.	▪ Cut & fill work to widen/straighten existing access routes, could encounter subsurface utilities or old pipelines. ▪ Hazards associated with working with large pieces of heavy equipment.
Excavation of materials	▪ Working around heavy equipment with limited visibility could result in collision of vehicles. ▪ Potential to encounter unknown or unsuitable material during excavation. ▪ Dust generation.
Highway transport of waste material to landfill	▪ Long distance highway driving hazards include collision, loss of control, fatigue, distraction. The one-way trip to the landfill will be an 8 to 10 hour drive.
Radiation Exposure from airborne material	▪ Personnel must stay in areas designated by Health Physics staff. Protection by location will be the same as implemented for chemical and asbestos airborne and will depend on wind direction, total distance and periodic analysis of airborne particulates.

[1]The potential risks identified in Table 5-1 should be considered preliminary, and may be expanded to include other risks that may be identified in discussions with the contractor prior to the removal action and/or during the removal action as SEAs are developed and modified.

SECTION 6.0
REFERENCES

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